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ABSTRACT

The problems and practices of science education in the community college are discussed in this paper. First, the community college's contribution to and position in American higher education is examined, especially with respect to enrollment and curricular trends. Next, the results of a national study of community college science education and a study of science programs in the Los Angeles Community College District are highlighted to provide an overview of two-year science education. This overview provides information on: (1) enrollment trends; (2) course levels; (3) course completion ratios; (4) students' reasons for taking science; (5) grades as predictors of future success; (6) the availability of student support services and students' use of them; (7) instructors' perceptions of their students' abilities; and (8) instructors' perceptions of their needs to improve their courses. Drawing upon these findings and upon the literature on community college science programs, the report then presents several conclusions about two-year science education and offers recommendations for the future. These recommendations call for offering courses through community services; more short-term, laboratory experience courses for career students; more remedial science preparatory courses; the required use of support services by students; and the establishment of a national exchange to disseminate information on two-year science education. Data tables from the two studies are appended. (KL)

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THE SCIENCES IN AMERICAN COMMUNITY COLLEGES

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(Washington, DC, January 7, 1982)

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Paper Presented at American
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The Sciences in American Community Colleges

Arthur M. Cohen

I am here representing the ERIC Clearinghouse for Junior Colleges at UCLA which has been collecting information about community and junior colleges nationwide for the past 15 years. I represent also the Center for the Study of Community Colleges which has conducted research on community-junior colleges nationwide for the past seven years. Those of you who are not fully apprised of the magnitude of the two-year community-junior college effort in America should know that there are 1,250 such institutions with 4.8 million students. That represents 40 percent of all the enrollments in higher education. More than half the students who begin college in America begin in a two-year college. Five out of eight of those students are part-timers. Although the community colleges enroll a large number of adults, the median age is still below 22--that is half the students are in the traditional college-age population. Most of the students are in career programs (slightly over 50%). Two-year colleges, thought, still have a mission in collegiate or transfer education.

Overall, the community college function includes the five Cs--collegiate; career or occupational; continuing or adult education which includes personal interest courses and occupational upgrading; compensatory, remedial, or developmental (that is trying to teach them what they didn't learn in the first 12 years) and community service which is a grab bag of short courses, part-time involvements, and recreational and cultural activities for the benefit of the public. But in the past 15 years, the community colleges' greatest contribution to American education has been that of access. Sixty percent of all the minorities in higher education are in community colleges. The colleges have few entrance requirements--not all of them require even a high school diploma. Very few

require high school grade point average or test scores. Anyone is welcome. They attract people who have been to college elsewhere, senior institutions, dropped out, come back into the community colleges. They have special programs for all types of returning women, handicapped people, single homemakers, and special interest programs for everyone who might not otherwise be attending school.

Within that enterprise, within an institution that serves such a broad cut of the population, half the people being just out of high school, and the other half being adults all the way out to senior citizens, there is a lot of lateral curriculum. The curriculum cannot be understood in linear fashion--go through high school, finish high school algebra, enter the community college and take college algebra, then take calculus and transfer to the university. The institutions don't do much of that. There is a lot of internal rotation, a lot of movement away from mathematics, a lot of movement away from careers requiring science. Many of the younger people enter the community college thinking they will embark on a science career and then find that internal rotation so easy, the curriculum being so flat, so lateral, that they move away from science.

Community colleges are on the bottom of the hierarchy in higher education. They don't get the best students typically. Perhaps 5 or 10 percent of their students are good, solid, traditional college-going, self-directed individuals. The rest of them can be characterized in another way--perhaps all the way down to the level of casual drop-ins. The staff gets little feed from research. They do strive for innovations in teaching, and they try to build levels of courses for different purposes. There is an incredible array of levels and types of special courses--chemistry for nurses, botany for forestry students, sociology for police officers. They will invent a course if they can find 15 or 20 people to sit in it. They emphasize science careers for technologists. They are not preparing people who will be the hard-core scientists. They deal with the

population of students who tend to be less literate in English and mathematics than their counterparts in senior institutions.

In the community colleges currently 90 percent of the enrollments are in courses for which there is no prerequisite--that is first-time entry courses. The colleges, as an example, offer introductory sociology and introductory psychology, but less than 20 percent offer the sociology of any special groups and less than 40 percent offer abnormal or social psychology. Around 5 percent of the students complete two years at the community college and transfer to a university at the junior level. We do not know how many drop out before completing two years and transfer because there is a lot of back and forth-reverse transfers, concurrent enrollments where they take community college courses and university courses at the same time, a lot of one semester at the community college then transfer to the university and come back again--a lot of that drop in, drop out phonomenon. It is difficult to get good data about students in community colleges.

Under grants from the National Science Foundation's Science Education Division we did two studies--one national and one of the Los Angeles Community College District. The Los Angeles District enrolls 135,000 students, making it the 4th largest higher education structure in America. We define the sciences in community colleges as including all the agriculture, biology, chemistry, the earth and space science, and the social sciences and mathematics. Our surveys include national samples of science faculty, national studies of curriculum and enrollments, and surveys of faculty, and students and analysis of students transcripts in the Los Angeles district. We classified science courses in three ways: (1) developmental or compensatory or remedial--that is, less than college level; (2) the courses for which there is no prerequisite--that is, the introductory courses; (3) those in a sequence, those for which there is a prerequisite, those designed especially for majors.

The enrollments can be extrapolated from a sample of 175 institutions in 1978 to the universe of 1,250. In the humanities history, political science, foreign languages are the big three. In the sciencesu mathematics including computer science is first. Then come psychology, biology, sociology, tailing all the way down to 35,000 students studying physics among 4.8 million community college students nationwide. (Table One).

We looked at the ratio of science enrollment (Table Two) and the levels of the courses these people are studying. In 38 colleges in six of the largest districts in the nation, Chicago, Dallas, Los Angeles, Phoenix, Miami, and St. Louis, which together enroll about 15 percent of the students in the nation, 60 percent of the mathematics enrollments are less than college algebra, that is arithmetic (Table Three). There is practically no remedial social science. And the 3 percent of remedial enrollments in the other sciences is comprised almost entirely of chemistry. As for the courses with prerequisites, the chemistry, physics, earth and space, and so forth, are largest, followed by social science. Only 15 percent of mathematics enrollments are in advanced courses.

The drop-in, drop-out phenomenon affects community colleges greatly because they are open-access institutions, making a plea for people to come in when they want, drop out when they want, come back again. There's almost total forgiveness. Most of the institutions will allow students to withdraw without penalty up until the last week of the term. This shows up in the data on course completion ratios. The completion ratio is running about 2/3 in the sciences, a little better (72%) in the social sciences, and less than 60 percent in mathematics. This refers to students who started a course, any course, in any of these areas and completed it with a grade (table Four).

How do students get into science, how do they leave science? We asked 6,400 students in the Los Angeles district. How did you get into this course?

They answered, "Someone in my high school told me about it," "I saw an announcement," "A counselor encouraged me to take a science course." The counselor encouragement shows up as very low. It is less encouraging of science careers for students than it might be probably with good reason, since the level of literacy of the students may be somewhat low and the counselors are afraid to put students into science courses where they are not going to do well. The counselors will say very readily, "We want the students to have a positive experience, and so we're going to put them into something other than science." (Table Five).

Student grades in their first science course are highly predictive of their subsequent grades as you would imagine, but there is an interesting data figure here. In Los Angeles, students who get A, B, or C in their first science course are more likely to enroll in and pass a subsequent science course. But of those who withdraw from the first science course, 30 percent will not complete the second science course. The "F" is a better predictor of success in the subsequent course than the "W". There is something about persisting through to the level of "F" that suggests the student needs the course for a career program goal. Dropping out and subsequently enrolling tends to predict dropping out again. (Table Six).

There are a variety of support services available to students. We asked, "How confident are you in your ability to do the reading that it takes to finish this course?" Of those who said "Yes, I'm confident," 24 percent had gone to the reading lab for help whereas 28 percent of those who said "I'm not confident" had gone to the reading lab for help. The ratio of people who seek help in reading, writing, math, who go to the math laboratory or study skills center, tends to be little different whether or not they feel confident of their abilities.

That's understandable when you look at another question. We asked the students "Why don't you go and seek help?" And they said, "I don't have time." "I'm working," "No one told me about it," and "I didn't see any reason why I should." There is a tendency to use the institution as a consumption environment. "I will go there and give the course an hour. If I can get all I need in that hour, that's good and I'll pass the course and something good will happen. If I can't, that's o.k. because I'll just come back next time and try it again." The students are saying in effect, "Why should I take the extra time? No one is forcing me to do it."

We asked the instructors, "Do you think your students are capable? How many of your students are able to understand the reading assignments that you give them? How many express themselves satisfactorily when reading? When speaking? How many do you think can or will spend a concentrated period of time--two hours or longer--studying for this course?" Six percent of the instructors felt that their students would or could study for two hours. Fourteen percent felt that their students could express themselves adequately in writing. One out of four felt that their students had the necessary time to complete the course assignments. These are instructors talking about their own students. One in four says, "I think they have the time to devote to my course."

We asked instructors in our national sample, "Your course may be very good. What would it take to make it better?" They would like better media and instructional materials and they wish they had time to develop their own. They wish they had better students. More than half said, "I wish I had students better prepared to handle my course requirements." Has there ever been an instructor in the world who didn't wish for better students? And 29 percent wished for smaller classes (Table Seven).

The ERIC Clearinghouse collects documents about science and all other areas in community colleges nationwide. As a review of those documents and in reporting some of our own studies, we published in 1980 a set of 12 monographs,

one on each discipline in the sciences--psychology, chemistry, mathematics, and nine others. There are a lot of documents in the ERIC system on innovations, little tricks that single teachers or faculties in a certain institution have tried to encourage better instruction and better learning on the part of their students. Some of them are reported in the monographs. Some of the more recent ones didn't get in. Many report the use of microcomputers, as, for example, the use of microcomputers for tutorials and to teach trigonometry in Oklahoma City and Albany, Georgia. We have documents on competency-based instruction in algebra at the community college in Allegheny County in Pennsylvania, on ways of relieving math anxiety in Spokane Falls Community College, on teaching basic math using problems related to careers at Kirkwood, Missouri Community College. We have a description of the math learning laboratory at Pima Community College in Arizona, on chemistry anxiety reduction at American River Community College in California, on problems with an interdisciplinary social science course at Prince George's Community College in Maryland, and so on. The ERIC collection includes a number of reports that teachers have written about what they are doing in the classroom to try to help move their students into and through the science programs.

In our own studies over the past seven years and in our observations of the literature over the past 15 years, we've come to realize that the community colleges have gone through a rather marked transformation. From grades 13 and 14--that is the entry into higher education--they have become grade 13 and less. That is, the paucity of enrollments at the sophomore level--the grade 14 component of the community college--has been severely weakened in the past 15 years. It shows up in the courses for which there is a prerequisite. It shows up in the

rate of transfer. The curriculum has been stretched to do all the remedial work that the secondary schools were unable to do for whatever good reason, and it has affected the program at the sophomore level. It takes an institution of at least 7,500 students to support one specialized course in sociology, one specialized course in psychology. A student can get but few specialized courses at the sophomore level in the smaller institutions.

Now, this is not necessarily to deplore a phenomenon, but only to help an audience understand why the transfer rate is so low. It's a downward spiral. Fewer students aspire to transfer; therefore, fewer students stay through the sophomore year; therefore, we offer fewer sophomore-level courses; therefore, students can find fewer sophomore courses so they are less likely to stay, and so on. There are entire states where the community colleges are not expected to pass through any transfers. But there is an opportunity here. If the community college has become less a transfer-pass-through-to-the-junior-level institution, if it has dropped into picking up what the high school has let go, then there is an opportunity for a better connection between community colleges and secondary schools. In the early years of the community colleges, when most of them grew out of secondary school districts, it was quite common for an instructor in physics to teach his physics classes in the secondary school during the day and teach in the community college at night. The community college courses may have been offered in the same building. In the past 20 years or so, that connection has been broken. The community college instructors tend not to come from the secondary schools. They turn their backs on that institution and our data shows them saying, "My class is just like the class offered at the freshman level at the neighboring university." What they don't realize is that only 5 percent of their students are going to transfer. And since 95 percent of them have come from a secondary school somewhere, the course articulation might well

be built with the secondary schools.

The insturctors might also do better in recruiting students from the secondary schools for the hard academic subjects. We asked in our national surveys, "Have you ever gone into your local secondary school to attempt to recruit students to your courses?" And by their own admission, only one in ten said yes. That is, 90 percent of them didn't even think enough about that to lie about it! They said "No, it wouldn't occur to me to articulate my course with the secondary school."

We've been suggesting that there is an opportunity to teach science, particularly science literacy through the community service programs in community colleges. Some of them have very well developed community service cultural forums, recreational short sequences. There is a chance for the regular faculty to bridge out into the community service areas. In most institutions, though, community service is run like a separate division-- like university extension--and there is not enough cross-over. There is an opportunity to recruit students out of the community service areas into the regular program; there is an opportunity to try specialized courses that you can't fill at the sophomore level, but that you can offer for non-credit through community service and fill them there.

We are recommending more types of remedial science prep classes. Except for mathematics, and to a lesser extent, chemistry, few courses are designed to prepare students to move into the regular college program. Social science depends almost entirely on literate students. There are very few social science courses that make any attempt to deal with the relatively underprepared students. We think there should be more social science for occupational students. You find chemistry for technical students. You find a lot of biology for allied health. But there is not enough in concepts of anthropology, concepts stemming from

economics or from political science for students in career programs. We are recommending more interdisciplinary social science. Only 7 percent of the colleges nationwide offer a course called Interdisciplinary Social Science or Principles of Social Science across the disciplines. These types of interdisciplinary courses could be required for more students.

We are recommending short courses, modules, laboratory experiences for students in career programs. We are recommending that support services be mandated. It seems that if students will not go to the reading lab or the math lab unless it is required of them, then you're just going to have to say, "If you want to stay in this course, as a condition of your continued enrollment, this course meets three hours a week, and you owe me six hours a week in the math lab, or six hours a week in the reading lab. And you're going to have to punch in there." Where that has been tried, it has been phenomenally successful. The students are not self-directed, they are not willing to put themselves into those extra classroom learning situations. The instructors are going to have to do it for them.

As for the national scene, we think I could echo Mr. McCurdy's comments on behalf of the Science Education Division. We need continual monitoring of the sciences in community colleges. We need to know where the innovative courses are and how we can export them. We need a biennial census of community college courses, enrollments, and completions. We need student information. We need to know why students enroll, what they achieve, why they dropped out. Let me give you one bit of information that can come from a carefully designed student study. On a careful sample basis in California community colleges, which enroll 1.3 million students, in response to the the question, "Why did you come to the community college?", one in six said "To be connected with a job." Not to learn the skills necessary to perform on a job, but to find out where

the job is, which is an indication of why the so-called drop-out rate is so high. What does drop-out mean when a student comes to be connected with a job, spends three or four weeks in a course, hears from the instructor or some of the fellow students where a job is, and goes and gets it and leaves school? In that light, the whole idea of college crop-out pales. We think there should be studies of science literacy. And we think there should be a national information exchange regarding science in the community college.

Thank you.

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Total Enrollments and Average Class Size in Community College Humanities and Sciences, 1977-1978

Humanities	Total Enrollment	Average Class Size	Sciences	Total Enrollment	Average Class Size
History	335,000	33	Math/Computer Sci	449,000	28
Political Sci/Govt/Law	255,000	31	Psychology	225,000	39
Foreign Languages	162,000	19	Biology	208,000	39
Literature	132,000	23	Sociology	204,000	35
Interdisciplinary Humanities	90,000	37	Engineering/Engr Tech	128,000	24
Philosophy	89,000	27	Economics	103,000	35
Art History & Appreciation	60,000	31	Chemistry	73,000	30
Music History & Appreciation	46,000	30	Earth & Space Science	66,000	34
Cultural Anthropology	36,000	31	Physical Anthro & Interdis. Soc. Sci.	44,000	30
Religious Studies	under		Agriculture	38,000	26
Ethnic Studies	20,000	28	Physics	35,000	24
Total Average Class		28	Total Average Class		31

Source: EXTRAPOLATED FROM NATIONAL SAMPLE OF 175 COLLEGES TO A UNIVERSE OF 1250 COLLEGES.

PROPORTION OF TOTAL INITIAL COURSE ENROLLMENTS IN SCIENCE, SOCIAL SCIENCE, AND MATHEMATICS AT EACH OF SIX COMMUNITY COLLEGE DISTRICTS. FALL 1980.

	CHICAGO	DALLAS	LOS ANGELES	MARICOPA (PHOENIX)	MIAMI-DADE	ST. LOUIS
SCIENCE	12%	7%	7%	9%	11%	8%
SOCIAL SCIENCE	11%	13%	10%	10%	14%	11%
MATHEMATICS	8%	9%	6%	7%	9%	11%
DISTRICT DUPLICATED ENROLLMENT	133,770	114,643	226,997	179,496	141,954	82,256

PERCENTAGE OF TOTAL DUPLICATED COURSE ENROLLMENTS AT FIVE COMMUNITY COLLEGE DISTRICTS[1] IN SCIENCE, SOCIAL SCIENCE, AND MATHEMATICS BY COURSE LEVEL. FALL 1980.

	REMEDIAL	COURSES WITHOUT PREREQUISITES	COURSES WITH PREREQUISITES
SCIENCE	3%	65%	32%
SOCIAL SCIENCE	< 1%	79%	21%
MATHEMATICS	60% (< College Algebra)	25%	15%

1 Information from Maricopa Community College District did not lend itself to this type of analysis.

COURSE COMPLETION RATIOS IN SCIENCE, SOCIAL SCIENCE, AND MATHEMATICS COURSES AT EACH OF SIX COMMUNITY COLLEGE DISTRICTS. FALL 1980.

	Chicago	Dallas	Los Angeles	Maricopa* (Phoenix)	Miami-Dade	St. Louis	Total
Science	64%	67%	64%	76%	63%	72%	67%
(Initial enrollment)	16,599	7467	16,627	15,646	14,935	6465	77,739
Social Science	63%	74%	65%	82%	76%	76%	72%
	14,561	14,593	23,230	17,173	19,109	8853	97,519
Mathematics	56%	55%	50%	69%	59%	60%	58%
	10,197	10,663	14,328	11,737	12,576	8826	68,327

* Maricopa data differs from the other district data in that course completion figures include not only students who successfully completed courses with grades of A, B, C, D, satisfactory and credit but also those who received grades of F, unsatisfactory, and no credit.

TO WHAT EXTENT ARE STUDENTS ENCOURAGED TO ENROLL IN SCIENCE-RELATED PROGRAMS?

	LA District (N=6,426)
Someone in my high school (counselor, teacher, college recruiter) told student about career opportunities available in the sciences.	24%
Someone in my high school told student about the science programs and courses at West L.A.	13%
Student saw announcements (flyers, posters, newspaper articles) advertising science classes at West L.A.	38%
Student saw announcements at West L.A. advertising a special program, club, lecture, or exhibit on some aspect of science.	34%
A counselor or faculty member at West L.A. encouraged student to take a mathematics course.	23%
A counselor or faculty member at West L.A. encouraged student to take a science course.	19%
Student discussed career opportunities in science with a faculty member or counselor.	19%

STUDENT GRADES IN THEIR FIRST SCIENCE COURSE

	1A DISTRICT
A, B, OR C	55%
D, F, OR I	14%
W	30%

IMPORTANCE OF THE FIRST SCIENCE COURSE

THE HIGHER THE GRADE STUDENTS RECEIVED IN THE INITIAL SCIENCE COURSE, THE MORE LIKELY THEY WERE TO ENROLL IN AND COMPLETE SUBSEQUENT SCIENCE COURSES.

STUDENTS WHO WITHDREW (W) OR WHO RECEIVED AN INCOMPLETE IN THEIR INITIAL SCIENCE CLASS COMPLETED A MUCH SMALLER PERCENTAGE OF THEIR SUBSEQUENT SCIENCE COURSES THAN STUDENTS WHOSE INITIAL GRADE IN SCIENCE WAS C, D, OR F.

ALTHOUGH THIS COURSE MAY HAVE BEEN VERY EFFECTIVE, WHAT WOULD IT TAKE TO HAVE MADE IT BETTER?

	Percent:
1. More freedom to choose materials	9
2. More interaction with colleagues or administrators	18
3. Less interference from colleagues or administrators	4
4. Larger class (more students)	8
5. Smaller class	29
6. More reader/paraprofessional aides	13
7. More clerical assistance	17
8. Availability of more media or instructional materials	36
9. Stricter prerequisites for admission to class	31
10. Fewer or no prerequisites for admission to class	1
11. Changed course description	6
12. Instructor release time to develop course and/or material	38
13. Different goals and objectives	4
14. Professional development opportunities for instructors	25
15. Better laboratory facilities	21
16. Students better prepared to handle course requirements	53
17. Other	10

SOURCE: NATIONAL SAMPLE OF 1275 INSTRUCTORS AT 175 COLLEGES.

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